DNR-85-012-AK

STATE OF MINNESOTA
OFFICE OF ADMINISTRATIVE HEARINGS

FOR THE MINNESOTA DEPARTMENT OF NATURAL RESOURCES

In the Matter of Determining the
FINDINGS OF FACT,
Natural Ordinary High Water Level
CONCLUSIONS,
of Lake Pulaski, Wright County.
RECOMMENDATION
AND
MEMORANDUM

The above-ent it led matter came on for hearing before AI Ian W. Klein , Administrative Law Judge, on March 26 , 1 985 , at the Wright County Courthouse Annex, Buffalo, Minnesota. The hearing continued through March 29 , 1985, in Buffalo. It was reconvened on April 1 , 1 985 , at the Office of Administrative Hearings in Minneapolis. The hearing adjourned on April 1, 1985.

Appearing on behalf of the Minnesota Department of Natural Resources were Special Assistant Attorneys General A. W. Clapp, III and Beverly M. Coner ton, Second Floor, Space Center Building, 444 Lafayette Road, St. Paul, Minnesota 55101. Appearing on be half of the Save Lake Pulaski Association were William J. Keppel and Gregory A. Fontaine of the Firm of Dorsey & Whitney , 2200 First Bank Place East , Minneapolis, Minnesota 55402 Appearing on behalf of the City of Buffalo was its Mayor, Gerard Melgaard, 212 Central Avenue, Buffalo, Minnesota 55313.

The record in this matter closed on August 2, 1985.

Notice is hereby given that, pursuant to Minn -Stat. 14.61 the final decision of the Commissioner of Natural Resources shall not be made until this Report has been made available to the parties to the proceeding for at least ten days, and an opportunity has been afforded to each party adversely affected to file exceptions and present argument to the Commissioner. Exceptions to this Report, if any, shall be filed with the Commissioner of Natural Resources, 500 Lafayette Road, St. Paul, Minnesota S5146.

STATEMENT OF ISSUE

What is the ordinary high water level of Lake Pulaski?

Based upon all of the proceedings herein, the Administrative Law Judge makes the following:

FINDINGS OF FACT

Jurisdiction

1. On February 1, 1985, the Commissioner of Natural Resources issued a Notice of and Order for Hearing, indicating that a hearing in this matter would begin on March 26 in Buffalo. The Notice further indicated that the

purpose of the hearing would be to make a new record from which the Commissioner could make a new determination of the natural ordi nary high water level of Lake Pulaski. Copies of the Notice were mailed to the Administratlve Law Judge, Mr Keppel and the Wright County Journal - Press on that same date.

2. Minn . Stat 105. 39 , subd . 3 (1 984) provides that the Commissioner of Natural Resources is responsible for the control of public waters, the establishment and control of lake level is, and the determination of ordinary high water level of any public water. Minn. Stat. 105.43, provides a process for applying to the Commissioner for the establishment of the natural ordinary high water level of any public water. For purposes of this proceeding, there is no legal distinction between the term "natural ordinary high water level" and "ordinary high water level". The abbreviation "OHWL" will be used.

3. Lake Pulaski is a "public water" within the meaning of the statutes. See, Minn. Stat 105 . 37, subd . 1 4(a), (c) and (h) .

4. On February 1 3 , 1 985 , copies of the Notice were mailed to the Wright County Board of Commissioners , the Wright County Soil and Water Conservation District , the City of Buffalo, the U S. Army Corps of Engineers , the Minnesota Environmental Quality Board, and various individuals representing a number of different landowner groups around Lake Pulaski.

5 . On February 7 and again on February 14, the Notice of and Order for Hearing was published in the Wright County Journal - Press.

6. On February 25, the Notice of and Order for Hearing was published in the EQB Monitor, volume 9, issue 18 at page 76.

7. On March 19, a Petition to Intervene was filed by the City of Buffalo.

8. On March 22, a Prehearing Conference was held at the Office of Administrative Hearings in Minneapolis. At that time, it was determined that there was no objection to the Petition of the City of Buffalo, and the Petition to Intervene was granted.

Prior OHWL Determinations

9. In August of 1964, a Department survey crew was sent to Lake Pulaski to determine whether certain filling activity was below the OHWL or not. The survey crew took the elevations of a number of trees, beaches, beach lines, ridges, and other physical features around the north part of the lake (where the filling was taking place) . The lake was measured at an elevati on of 958 .7 feet. The survey crew chief , Kenneth D . Reed , determined that the OHWL was at 960.5 feet. Exs. 326 and 357.

10 . There was no public hearing , published notice , or other legal proceeding to establish this 960.5 foot level as a formal OHWL. The purpose of the survey was to determine whether the filling was below tie OHWL or not. it

was not intended to be used to formally establish the OHWL of Lake Pulaski Nonetheless , the Department , the County, and the City of Buffalo all used this 960. 5 figure as a basis for land use regulations, planning , and construction. The loc ation of a part of the City' s sewer and water system, bui It in the early 1970s, was based on this number. Tr. 1-141-143; 5-36; and Ex. 348.

11. In 1981, following a number of citizen complaints and permit applications, the Department decided to commence a formal proceeding to officially establish the OHWL of Lake Pulaski. The Department's survey crew was sent to Lake Pulaski in July of 1 981 , and determined that the lake's elev ation had ris en to 961 . 6 feet. The crew talked with residents, and took elevations of numerous trees and physical features around the lake. After examining a II of the data in the Department's files and analyzing the data collected in the field, the crew chief, Kenneth D. Reed, decided that the proper OHWL for the lake was 968.8 feet.

12. On January 7, 1982, a public hearing was held in Buffalo as part of the forma I proceeding to es tablish an OHWL for the lake based on the evidence presented at that hearing , a State He aring Examiner recommended to the Comm issi oner t hat the OHWL be establi shed at 968 . 8 feet .

1 3 . On June 11, 1982, the Commissioner issued an Order formally est ablishing the OHWL of Lake Pulaski at 968 . 8 feet . There was no appe a I of this Order, and the appeal period expired.

14. In late December of 1984 or early January of 1985, the Department, in response to numerous complaints and a lawsuit , determined to conduct a new proceeding to establish the OHWL of the lake - As noted in Finding 1 above, the Commissioner specified in his Notice of Hearing that the purpose of the 1985 hearing was to make a new record from which he could make a, new determination of the OHWL of the lake.

Parties

IS. The Department of Natural Resources ("Department" or "DNR") is an agency of the State of Minnesota, duly authorized pursuant to Minnesota Statutes, Chapter 84. The Department is responsible for, among other things, the establishment of the natural ordinary high water level of an,, public water and the establishment, maintenance and control of lake levels. Minn . Stat 105.43 and 105.39, subd. 3. (1984).

1 6 . The Save Lake Pulaski Associ ati on , Inc . ("Association " or "SLPA") is a nonprofit organizati on incorporated under the laws of the State of Minnesota . The members of the SLPA reside and own property adjacent to or near Lake Pulaski, Wright County.

1 7 . The City of Buffalo ("City" or "Buffalo") is a municipal corporation located adjacent to and southeast of Lake Pulaski. Approximately the southern one-half of Lake Pulaski's shoreland is located within the municipal boundaries of Buffalo.

Description of Lake Pulaski

18. Lake Pulaski is located in Wright County. It has a general northeast to southwest orientation, with an approximate length of two miles and a breadth of one mile.

19. Lake Pulaski is a landlocked lake, with no known history of an outflow.

20. Lake Pulaski has an area of about 770 acres, and a maximum depth of 87 feet (as planimetered and measured by the DNR in 1968, based upon aerial photographs taken in October of 1953.) Its present area and depth are greater than those figures.

21. The shoreline of Lake Pulaski is almost completely developed, and there are more than 240 homes built around it. These include both year-round homes and summer cottages. The first structures built around the lake date back to before 1853. Tr. 1-169. The Lake is a popular recreation area which offers swimming, boating and fishing. Residents speak with pride about its past water quality and clarity, but recent high waters have flooded septic systems and sewer lines, causing concerns about water quality.

22. The "urbanization" of the lakeshore has been accompanied by a great deal of grading, leveling, filling and landscaping which has obscured or destroyed natural land features and natural objects (such as trees) around most of the Lake. In 1981, local landowners informed a DNR survey crew that most areas around the Lake were not natural and had been either filled or excavated to accommodate various purposes. Tr. 1-77. For example, during dryer times, there was a definite dividing line between "Little Lake Pulaski" and Lake Pulaski. The former is located immediately to the north of the latter. The land dividing these two has, however, been tremendously modified by artifical means over the years. One local contractor testified as to "thousands of loads" of fill placed in and around the area dividing the two (Tr. 4-185), and the Department's files contain numerous documents evidencing digging and filling there. (See later Findings).

23. Actual recording of water levels on Lake Pulaski did not begin until

1941. Readings taken between 1941 and 1946 illustrate that the Lake level varied between 951.7 feet above mean sea level (National Geobetic Vertical Datum, 1929) and 955.4 feet. Between 1947 and 1981, only sporadic readings are available. Those readings indicated a low of 958.7 and a high of 962.5. From 1981 to the date of hearing (March 26, 1985), more frequent readings are available. Since 1981, the Lake has varied between a low of 960.9 and a high of 965.6. Ex. 6, p. 12, appendix DI Tr. 1-84. The elevation recorded on the first day of the hearing, 965.63, is the highest recorded elevation in the record.

24. A site visit of certain selected areas around the lake (and around Little Lake Pulaski) occurred during the hearing, on the afternoon of March 2 7 . The Judge was accompanied by counsel and representatives of the parties. The parties selected the locations to be viewed. A summary of the viewing was subsequently prepared, and is in the record as Ex. 804.

ordinary High Water Level: Definitions and Types of Evidence

25. Minn. Stat. 105.37, subd. 16 (1984), provides the applicable definition of "ordinary high water level". It means:

> . . . the boundary of public waters and wetlands, and shall be an elevation delineating the highest water level which has been maintained for a sufficient period of time to leave evidence upon the landscape, commonly that point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial

26. The record of this proceeding discloses three d fferent types of primary evidence for determining the OHWL for Lake Pulaski, They are vegetation (primarily trees), soils, and physical objects and marks. In addition to those pieces of primary evidence, the record discloses numerous pieces of secondary evidence, such as estimates of past lake levels based on recollections, photographs, etc., and elevations of houses and other structures.

Primarv Evidence: Vegetation

27. All species of terrestrial vegetation inundated by water will die in a relatively short time (i.e., one to three years) if the period of inundation is not temporary. Tolerance to inundation, however, variety by species. Generally, a tree requires an unsaturated soil beneath it at least equal in depth to its diameter (for hard wood trees) or one-half its diameter (for soft wood trees) in order to survive. Tr. 1-90-91; Ex. 6, p. 6: Ex. 521, pp. 3-4.

28. The Department has, over the years, developed a methodology whereby the ordinary high water level of a lake is estimated by selecting a number of trees which are near what is believed to be the OHWL, and then measuring the ground elevation at the base of each tree, subtracting either the diameter at breast height for hard woods (or one-half the diameter for soft woods) from the base elevation in order to arrive at a "reduced elevation". The average of the reduced elevations of all of the selected trees equals the OHWL. Tr. 1-91-95.

This methodology is used because trees are the most permanent expression of upland vegetation. Other forms of upland vegetation, Such as grasses and shrubs, require only a short period of time to establish themselves, and thus will follow lake levels as they fall. Conversely, aquatic vegetation, such as cattails, also require a relatively short period of time to establish themselves, and will thus follow lake levels as they rise. The line separating terrestrial shrubs from cattails will thus vary, over a relatively short period of time, as the lake rises and falls. Trees, on the other hand, take longer to grow and do not disappear as lake levels change.

29. The reliability of an OHWL estimate based upon this; tree elevation analysis methodology depends upon which trees are selected for study. Despite the mathematical precision which the computations suggest if the judgment used to select the trees is faulty, then the result will be faulty.

One way to evaluate the appropriateness of the selection process Is to consider the age of the selected trees. This can best be understood by a hypothetical example, where there Is a line of trees spaced exactly one foot apart. This hypothetical line of trees is perpendicular to the shoreline, and the line extends from well above the water line to well below it. All of the trees in this line have been free from disease. None of the land around the trees has been altered by filling, excavation, landscaping or other artificial manipulation. It should be possible to take borings of the trees, estimate the ages from the borings, and then compute how long it has been since water has inundated the roots of the trees. By correlating the age of a tree with its elevation (reduced by the methodology described above), it would be possible to say that the lake has not reached and stayed a: elevation X for Y number of years. For a lake which has substantial rises and falls, (such as Pulaski) this method would assure knowledge of the highest level which the lake had reached and sustained long enough to kill trees.

30. In the case of DNR's use of the tree elevation analysis method at Lake Pulaski, 16 trees were selected for analysis. These trees were selected on the basis of (a) their location in an undisturbed area in what is refered to as West Pulaski Park or Buffalo Park, and (b) their proximity to a geological feature (which will be discussed more fully below) referred to as an "old lake bank". All of the trees selected were located between the top and the toe of this "old lake bank". Their proximity to this geological feature was the key determinant of their selection. First, the geological feature was identified, and then the trees were selected based on their location in relation to this feature. Tr. 1-119. The average of the reduced elevations for those 16 trees was 968.8. That survey and calculation was performed in 1981. No borings were taken of the 16 trees in 1981.

31 . In 1985, the Department took borings from 12 trees. Six of the bored trees were located on the top of the old lake bank identified in 1981. The other six were selected on the basis of being the largest trees which the Department could find which were located below the cold lakp bank elevation. Some of these lower trees were located in the park area, and others were located at other locations around the lake. Ex. 6, Appendix C, pp. C-1

through C-6, and Ex. 8.

Analysis of the borings indicated that five of the six trees which were located on top of the geological feature were more than 100 years old, with an average age of 111 years. The sixth could not be dated, as explained below. On the other hand, all of the six trees located below the geological feature were 56 years old or younger, with an average age of 47 years. Tr. 1-31.

32. In addition to the 12 trees selected by the Department for borings, seven additional trees, selected by the Association, were bored after the hearing had concluded. The parties agreed to have these trees bored because the Association had presented evidence, based upon estimates of age (not borings) that there were a number of trees whose ages ranged between 80 and 130 years old which were located at elevations well below the 968.8 elevation proposed by the Department to be the OHWL. Near the close of the hearing, the parties agreed that a number of those trees would be bored in an attempt to more accurately estimate their ages. Tr. 4-174.

33. Pursuant to the agreement, seven trees were bored. Two borings were taken from each tree. The borings were taken a,: breast knight, which is the standard procedure. Each party was given one set of borings , which they then forwarded to their respective experts for analysis. As was agreed, the experts submitted their estimates of age to the Judge. th e Department's estimates (which are contained in the post-hearing brief of the Department) were made by Ron Stoffel, a DNR forester. The Association's estimates (which are contained In Exhibit 803) were made by Ralph R. Greiling, a consulting forester.

Because the estimates varied substantially, the Judge suggested to the parties that an independent court-appointed expert be retained to examine the borings. Neither of the parties objected to this suggestion. The Judge appointed Dr. William J. Robinson, Director of the Laboratory of Tree-Ring Research at the University of Arizona. Dr. Robinson undertook the assignment and prepared a Report dated July 17, 1985. Table I (Appendix A at the end of this Report) contains his findings, in addition to those of the parties' experts. (All correspondence relating to this appointment has been inserted into the record as Ex. 805).

34. Based upon all of the comments from the various experts and an evalu ation of the ircredentials , the following a ges of these seven trees at issue are determined to be the most accurate:

How Oak - 74 years old
Carpenter-Poirier Cottonwood - 69+ years old
Strieff no estimate
Strzok 59),ears old
Loberg 60 years old
Walter (s) - 59 years old
Bickley - 43 years old.

35. The How Oak is still alive and healthy, It is 74 years old. Its reduced elevation is 964,56. From that data, it could be concluded that during the period 1911 - 1985, the Lake did not reach and maintain an elevation of 964.56 long enough to Kill the tree.

36. The Carpenter-Poirier Cottonwood has a reduced elevation of 963.35 feet. By April of 1985, it had begun to die. it is at least 69 years old.

It could be concluded that during the period 1916 to 1985, the Lake did not reach and maintain an elevation of 963.35 long enough to Kill the tree (except for recent times).

37. The same kind of figuring can be done for the other trees, but they are all younger, and so there is no point in computing the figures under the age theory adopted in this Report. (See Memorandum).

38. Ithere are problems, however, with both the How Oak and the Carpenter-Poirier Cottonwood. First of all, both are actually located on the shores of Little Lake Pulaski, not Lake Pulaski. As noted earlier, there has been a large amount of artificial manipulation of the narrow isthmus separating the two. In order for the elevation of either to be used in any

determinative manner in this case, it would be necessary to determine whether or not, during their lives , the isthmus blocked water from f I owing freely between the two Lakes at elevations of 963.35 or higher.

A 1 959 memorandum (Ex. II 2) in the DNR Lake Fi le indicetes the following:

> A Divis ion of Waters' file has correspondence on a channe I connecting the two [Lake Pulaski and Little Lake Pulaski I dating back to 1927. It has been opened and closed several times by various parti es

The file a I so contains a letter from a District Court Judge dated in 1 928 indi cating that the out let from Big Pu I aski into Little Pua Iski had been opened up twice "this spring" (presumably the spring of 1928) and that the Judge had undertaken to c lose it up himse If in June of 1 928 . The file also indicates that an inspection in the fall of 1927 disclosed a channel and that the channe I had been deepened at some undiscIosed ear Iier time - (Ex. 100). The Department's file contains numerous references to this channe I from 1 927 onward, with requests, orders and even indic ations of an arrest warrant re Iating to persons who had either excavated or filled the area from time to time over the years. It is found that the numerous openings and closings of the channe I make it imprudent to rely upon ei ther the How Oak or the Carpenter-Poirier Cottonwood as reliable indicators of water elevati ons on Lake Pulaski.

39. The other factor that rai ses suspici ons about reliance on the How Oak is the disagreement between the parti es about whether it is a "twin tree" or a single tree. The importance of this disagreement can be seen if one attempts to calculate the reduced elevation of the tree. If it is a twin tree, then the groud elevation of 969.18 should be reduced only by the diameter of the portion that was bored, which is presumably the 26.2 inch portion, which would result in a reduced elevation of 966.0 feet. If,-on the other hand, it is a single tree with a diameter of 55.5 inches, then the reduced elevation is 964.56 feet. In a case such as this where there is some need for precision, this difference is unacceptably large.

40. It is undisputed that there are hundreds, if not thousands, of trees and stumps located below elevation 968.8 feet. Many are now in the water and

have either already died or are dying. Both parties recognize the existence of these trees and the fact that they are "terrestrial vegetation". In addition, there are a large number of trees that already have been cut down which were on the lake side of the trees currently standing in water. Tr. 1, pp. 87-88, 121-122; Tr. 5, p. 78 and 140-141; Exs. 176, 19A and B, 520 at p. 72, 521, 565.

DNR does not consider these trees to be indicators of OHWL because they germinated and grew at a time when the lake was below what DNR considers to be the OHWL. The Association, on the other hand, believes that these trees are proper OHWL indicators because they are terrestrial vegetation. In fact, when computing its proposed OHWL (961.4 feet), the Association selected those trees which represented the first line of trees (moving from the water to dry land) which they could find. The Association selected 15 large trees which were all in the waters of Lake Pu Iask I and Litt Pu 1 ask I and applied the DNR's tree elev atIon methodology to them in order t0 reach the 961 . figure

For reasons discussed more fully in the Memorandum, these 15 trees are not proper indicator trees for determining !he OHWL using the tree elevation analysis method.

4 1 . A large elm tree (the Leonard ELm grew on the northern shore of Lake Pulaski until it died from Dutch Elm De sease in 1982. It had a base elevation of 968.87, and a diameter of 3.2 feet. The remaining stump is depicted in Ex. 520, at p. 77. The parties stipulated -that a slice taken from the tree (at approximately breast height) indicated an age of 139 years old. Tr 5-63 and 68-69. The tree, theref ore, germinate I and grew from 1 843 to 1 982 . The ground elevation of the tree is 968.87- The reduced elevation would be 965.67 (full diameter reduction, consistent of the DNR methodology, Ex. 6 at C-7). There are, however, Issues concerning ;Tie loc ation of this tree which rai se questions about its value as an OHWL indicator tree.

The Leonard residence is on the north shore of the main lake. Tr . 4-87 and Ex . 528 , marking entitled " Leonard " next to "Quady" . The first cabin bu I It on the lot was bu I It In 1 926 , and al though the re have been some additions over the years, the original cabin is still there. Tr. 4-87. The ground elevation of the cabin is 969.5- Ex. 541, p. (136) #79. It is depicted in Ex. 567, as the center cabin As can be seen from Ex . 567, the ground slopes upward from the water's edge (as it was in the summer of 1984) toward the cabin. The stump of the oak tree is located on the backs I de of the cabin. Ex. 520, p. 77. The cabin. therefore, stands between the lake and the elm tree , and has stood between ths two since 1 926 . in order for water from the lake to reach the oak tree or, the surf ace of the and , the water would have to ri se to at least 969.5. there is no sub stanitiatted evidence in the record that the lake has ever reaced such an-elevation, let alone an elevation which has maintained itself' long enough to kill the tree.

42 . Another problem arising in connection with the use of the Leonard elm is the question of whether there has boon any artificial manipulation of the ground elevations either in front of, - behind, the tree. It is known that the lot has been "modified slightly" be landscaping. Tr. 5-138-139. There Is a substantial variation in the elevations of the lot. On one part of the lot, the elevation of land 165 feet from shore is 971. 3, but on another part of the lot, the elevation 167 feet from shore is 967.33. Ex 520, pp. 85 and 65. it would appear from a photograph of the stump (Ex. 520, p. 77) that the ground elevation of the stump is a "natural" elevation. A local contractor testified that there was an old lake bank in thi s area whi ch he flattened out in the 1960s. His grading went west of (and included) the Leonarc lot. Tr . 4- 1 94 and 196. To the extent that the land !round the Leonard house has been landscaped , it calls into question the validity of any estimate based upon the Leonard elm.

43. It was suggested that regardless of the elevation of the front of the house, the Leonard elm is a valid idicator tree because there are lower ground elevations behind the house and water would have risen and inundated the Leonard elm from the northeast (from behind the house) if either Little Pulaski or Lake Pulaski would have risen to an elevation of 968.8 feet.

Association proposed Findings of Fact, Conclusions and Recommended Decision, fn. 75 at p. 68. A review of a blowup of the most recent topograhic map, Ex. 528, neither confirms nor denies this assertion. It is impossible to tell,' from that map, what the elevations are behind the house. There is testimony, however, that a ridge was graded at the Leonard's and up to four feet of fill was placed immediately to the east and northeast of the Leonard residence by the local contractor, Victor Corron. See, Yellow Area on Ex. 588: Tr. 4-196 and 5-184-185, 186-189. This fill would have raised the land. Before the fill, therefore, it would have been easier for water from that direction to impact the tree.

Credence to the theory that water would have inundated the elm from either side of the Leonard residence does come from the elevations at the Quady and Bossenmaier parcels. These elevations (965.7 and 966.4), when coupled with the elevation at the base of the tree (968.87) suggest the possibility that water could have reached the Leonard tree, albeit not in a direct fashion. The tree was more than 200 feet from the water's edge in the summer of 1984. At that time, the Lake was at approximately 965A feet. (Ex. 520, pp. 78-82).

44. In summary, the Leonard elm, with a base elevation of 968.87 feet and a reduced elevation of 965.67 feet, had an age of at least 139 years in 1982. Although the tree's location is more than 200 feet from the lakeshore, and protected at the front by land which Is at a level no less than 969.5, the tree is of value in determining the OHWL. The Leonard cabin was not built until 1926. The Judge has a reasonable degree of confidence that if the Lake did ever rise to an elevation of 968.8, that rise must have taken place before 1926. The existence of the cabin, therefore, is of no concern. The only caveat in connection with the use of the Leonard elm are (a) the grading and filling, (b) its distance from the shore, and (c) the higher ground protecting it from the Lake. But none of those constitute an absolute bar to its use,

and they are balanced by the fact that the land behind the Leonard cabin was substantial ly lower during the critical period (pre Corron fill) than it is today. Whi le relying on its reduced elevation is not as sound as it would be in the case of a tree closer to the water's edge, the existence of the tree at its ground elevation for so many years certainly casts some doubt upon the DNR's OHWL estimate of 968.8.

45. The only other trees demonstrated to be more than 100 years old are the five trees found on the top of the old lake bank in West Pulaski Park.

In examining these trees it must be noted at the outset that there are only five which have reliable estimates. A sixth, Tree #8, a 28.8 inch diameter American Elm, is at least 69 years old, but it is impossible to accurately estimate its real age, because an incomplete bcring was taken. While the DNR forester estimated the age at more than 100 years, the use of such an estimate is inappropriate. Therefore, there are five trees, all of which can be reliably said to be more than 100 years old.

Looking at the five trees, their reduced elevations range from 969.55 (age 108) to 970-17 (age 146). They include trees at 969.68 (101 years), 969.70 (101 yearsn 969.97 (10 years).

47 The DNR's estimate of 968.8 was based upon an average of 16 reduced elevations. One of the trees in the average, a 27-inch elm (the same as tree No. 4) was the subject of an inaccurate calculation in arriving at its reduced elevation. Twenty-seven inches is the same as 2.25 feet. When that 2. 25 feet is subtracted from the ground elevation (an average of 971.95), the reduced elevation should be 969.70. For some reason, the reduced elevation is listed as 968.4. That difference, however, does not significantly affect the outcome of the DNR's calculation. In fact, the erroneous number used by the Department results in a lower average than if the proper number was used. The error is noted here only to ass ist a reviewing court attempting to analyze the Department's calculation sheet at Ex. 6, App. C, p. C-7.

48 . I n summary, the Department has I dent ified five trees, &I more Han 100 years old, at reduced elevati ons of between 969 . 55 and 970 . 17. These trees, however, were selected only af ter the Department had I dentified the old lake bank and determined that its eIevations (top and toe) set the outer boundaries for where the OHWL must be located. Regardless of this selection process, however, wi th the except Ion of the Leonard elm, those trees are the on Iy trees which have been conc Iusively demonstrated to be more t han 100 years old. All of the other trees which persons believed to be old turned out, upon boring, to be subs tantial Iy Iess than 100 years old. While those younger trees had substanti a IIy lower eIevati ons (ranging down as low as 962 . 1 8 for the Loberg cottonwood, which turned out to be only 60 years old) , their age means that they cannot be reliable indicators of the OHWL consistent with the age test explained in the Memorandum.

Primary Evidence Exposed Tree Root

49 . At the West Pulaski park site, there was identified a twin basswood with lakeside elevation of 968.2 feet, and landside elevation of 971.7 feet. This tree leans noticeably toward the lake. See, Ex. 6, p. 39, photograph 15 and p. 33, photograph 4. The age of the tree is unknown. Attempts at increment borings were frustrated because the tree turned out to be rotten in

the middle. Tr. 1-147. There is a root extending in a roughly southerly direction, parallel to the lakeshore, away from this basswood tree. When Departmert personnel surveyed this root, they determined that the root had been washed and exposed by action of lake water. Tr. 1-148-149. The basis for this conclusion, however, was the relationship of the root and the tree to the geologic feature which the personnel determined was an old lake bank. There is no way to tell, from looking at the root in isolation, whether the root was exposed as a result of washing by the lake, or by surface water flowing over the root. Tr. 1-154-155. A close examination of the root during the site visit demonstrated that the root was, in fact, exposed, but that the soil above it had been washed out, so that water flowing directly down the hill would flow under the root. In light of all the foregoing, i t is specifically found that it is equally as likely that the root was exposed by water running down the hill as by wave action from the lake. Ex . 804, p. 3.

Primary Evidence: The Old Lake Bank at West PulasKi Park

50. The geologic feature in West Pulaski Park was the subject of a great deal of controversy at the hearing. The Department claims that it is an old lake bank and, in addition, that it shows signs of having been washed by the

waters of the lake. The Association, on the other hand, claims that it is an ice rampart formed thousands of years ago, and that it bears signs of erosion from surface water runoff rather than wave action. Since it is "evidence upon the landscape", it may be relevant to the determination of the OHWL.

51. The geological feature at West Pulaski Park was formed by the action of ice pushing against the shore. There was some debate at the hearing as to when this occurred. Mr. Liesch estimated that it occurred approximately 10,000 years ago during the waning stages of the Pleistocene glaciation. He believes this to be the case because of the size of the boulders in the feature, which are so large that they would have required great force to be moved. He believes that winters thousands of years ago were much more severe, and lasted for considerably longer periods of time, thereby creating lake ice which was much thicker than that of current times. It would take a thick piece of ice to be powerful enough to push such large boulders. Tr. 5-137-138.

Mr. Reed, on the other hand, agreed that it was formed quite a while back into history, but closer to modern times, such as a few hundred years ago. Tr. 1-130. He does not believe that it was formed by ice action, but rather that it was formed directly by wave action. Tr. 1-79 and 115.

Mr. Hobbs did not offer any opinion as to when the feature, itself, was formed. He agrees that it was formed by ice, but does not state when the feature was originally formed. Tr. 5-155.

52. On the south side of the lake, in Grifing Park, there is an ice rampart which was formed during geologic times. This ice rampart is illustrated in Ex. 520 at p. 58, and there are photographs of it at the start of Appendix B of that Exhibit. Based upon Fig. 11 at p. 58 of the Exhibit, it would appear that the feature has elevations of 972 at its toe and 975 at its peak.

53. There is also a geologic feature located on the north side of the main lake, at the Leonard residence. Although there were no precise measurements made of this feature, there was testimony that the Leonard cabin was built "right on an ice rampart" Tr. 5-138. The elevation in front of the cabin is 969.5. Ex. 541, P. (136)#79. The backside of the ice rampart was measured at 968.26 feet. Ex. 520, p 65.

The top of the controversial geologic feature at West Pulaski Park had an average elevation of 970.0, and the toe of the feature had an average elevation of 967.1. Ex. 6, p. 9.

54. While there is a reasonably close correlation in elevation between the feature at West Pulaski Park (967.1 - 970) and the feature at Dr. Leonard's (968.2 - 969.5), neither of those two reasonably correlates with the feature at Griffing Park (972 - 975). There is no reason to assume, therefore, that the Griffing Park feature was formed at the same time as the feature in West Pulaski Park.

55. The major difference between the feature at West Pulaski Park and the Leonard feature is existence of numerous exposed boulders at West Pulaski Park and the total absence of such boulders at the Leonard site. This however can

be explained by the comparatively steep rise at the park site, but only a gradual rise at the Leonard site. Compare, Ex. 6, p. 32, Photograph 2 with Ex. 520, App. 6, photograph 20 (top). This steep rise is graphically illustrated at Ex. 6, p. 23. It is possible, of course, that any such rise at the Leonard property has been artificially removed by grading, and that rocks have been removed from the Leonard yard, over the years, in order to make it more attractive. In fact, rocks have been placed along a path in front of the house, and along the front. See Ex 541, p. (136)#79.

56. It is found that the feature at West Pulaski Park was formed by the action of ice, and not by wave action alone.

57. The crucial issue about the geological feature in west Pulaski Park is not so much when it was formed, but rather whether the exposed boulders clearly evident protruding from its side have been exposed as a result of wave action or suface runoff.

It is undisputed that there are hundreds of boulders protruding from the lakeward side of the feature. Some of these can be seen in photographs, such as photograph 2 in Ex. 6, p. 32. There is, in fact, a noticeable concentration of these exposed boulders at an elevation approximately 4.5 feet above the water's edge at the time of the hearing (the lake was measured at 965.63 on the day the hearing started, and so this concentration would be at approximately 970.1 feet). Tr. 5-142-143. This line of boulders is not to be confused with a higher line of boulders, which is artificial. A path has been created along the top of the feature (by a Boy Scout troop) and rocks have been placed in an obviously artificial line along that pat,, as have been benches and picnic tables. This trail can also be seen in the photograph labeled 13 (top) of Appendix B, Ex. 520. Dr. Hobbs, who identified the concentration of boulders at breast height, specifically noted the existence of the rocks lining the trail. Tr. 5-148. He was not confusing the two.

The existence of the lower line of exposed woulders lends credence to the theory that it was the lake (rather than surface waters ruining down the hill) which washed away the finer materials and exposed the boulders. Tr. 1-154.

In addition, the credentials of those who examined the exposed boulders and concluded that they had been washed by wave action !ends credence to the theory. Dr. Hobbs is a geologist with the Minnesota Geological Survey. His specialty is glacial geology and the shape of land as it relates to glaciation in Minnesota. He has a B.S., M.S., and Ph.D. in Geology. His primary work responsibility is to prepare geologic maps of the state. Tr. 1-54.

Hobbs was "pretty confident" that the boulders had been exposed by wave action Even if he knew nothing else about Lake Pulaski, he would not build a house below those exposed boulders because of his confidence in wave action as the cause of their exposure. Tr. 5-148-149. hobbs was unable, however, to put a precise date on when the boulders were washed. He believed it would take more than one or two years to accomplish, and that it would be more on the order of tens of years, or ever hundreds of years to happen Tr. .5-147. Examination of the boulders did not assist him in pinning down any time frame, and he had no other basis for estimating when this wave action might have occurred other than the exposed tree root discussed earlier. Tr. 5-151.

Mr. Red has not had formal education in geology or hydrology, and holds no degrees. He has, however, been involved in ordinary high water surveys and investigations for most of his 23 years with the Department. Tr. 1--72-73. He has seen hundreds of lake banks during these years, and has been the Department's expert witness on ordinary high water matters since 1967. Tr. 1-79 and 117.

Mr. Leisch is a certified professional geologist, and has worked as a consultant since 1965. Prior to that time, he worked for 18 years with the United States Geological Survey and the Minnesota Conservation Department. He holds a B.S. degree in geology. He has been involved in solid and hazardous waste site evaluations, contaminant migration from waste disposal sites, water well development and redevelopment, geophysical surveying, ground water and surface water interaction investigations, and hydrologic studies. Ex. 520, Appendix A. He was assisted in this matter by Cathleen Vi11as. Ms. Villas holds a B.A. degree, and M.S. degree In geology. Her specialties include paleogeomorphology, coastal geology, sedimentology, stratigraphy, and quaternary geology. Neither she nor Mr. Leisch have ever tseen involved in an OHWL determination. Their testimony centered around the absence of any beach deposits either on the geologic feature or immediately lakeward of it. They reasoned that if the water had been at an elevation high enough to expose the boulders, it would have left a beach deposit which could be identified.

There is no evidence of washed boulders either at the Griffing Park ice rampart or at the Leonard rampart. While neither of those two sites are in as natural a state as the West Pulaski Park site, it is more likely that the absence of exposed boulders at those sites relates to the slope of the land. The slope at the West Pulaski Park is much steeper than at either of those two sites. The steepness of a slope is a determinant Of how cluickly fine materials will be carried away by the action of water leaving exposed boulders. Tr. 5-154.

In summary, weighing all the evidence discussed above, it is found that the exposed boulders in the geological feature at West Pulaski Park were exposed by the action of water from Lake Pulaski.

58. The fact that there is a line of exposed boulders at roughly 970.1, resulting from wave action does not, however, set an OHWL. It is also

important to know when the boulders were exposed, and how far from a "calm" lake level wave action would work on finer sediments. In other words, the strongest forces of waves are exerted during times of storms and other high-energy events which impel the waves into the shoreline. The results Of those high-energy waves would be noticeable at a higher elevation than the "calm" elevation of the lake. Tr. 5-180-181. Unfortunately, there is no reliable evidence in the record to suggest what differential (between calm levels and the washed boulders) might be applicable to Lake Pulaski. There is evidence, however, regarding the time that this washing may have taken place.

Dr. Hobbs testified that one could not determine time from the boulders, because they are resistant, and would be around for a long time. Based solely on the exposed tree root, however, Hobbs concluded that it must have been within the life of the tree. Tr. 5-151. When asked whether the boulders could have been exposed by wave action in a year or two, he stated that they could not. He thought that it would be more on the order of tens of years or hundreds of years . Tr. 5-147. Mr. Reed, who also believed that the bank had been washed by waters from the lake, opined that the bank was formed "quit? a while back into history, by that I mean maybe a few hundred years". Tr. 1-130. Reed bel ieved, however, that water was up to the bank as recently as the 1920's. Mr. Leisch, on the other hand, did not believe that there had been any washing of the bank by lake water during the period of civilization of the area. Tr. 5-137.

It is found that there is no reliable way to know when the lake washed the boulders, or at what "calm" elevation the lake was when it did wash them. Therefore, the mere existence of the washed boulders alone is of no direct help in establishing the OHWL.

59. There are other indicia of old lake banks, but none of them are generally rel iable to form a basis for an OHWL determination. Instead, they are mentioned here because they corroborate the existence of the feature in West pulaski Park.

The first of these is a concrete block wall built around a tree. The tree, and the wal 1, are located on the east-northeast side of the lake, in Unit 1 of the Pulaski Shores subdivision. This wall is depicted in Ex. 23A. it is located on the property of R. G. Torbert. This property has a ground elevation at the front of the house of 964.6. Ex. 541, photograph (38) #11. The elevation of the tree, however, has a base elevation of 968.7. Tr. 3-49. The purpose of placing the wall around the tree was to keep the tree from falling over when a lake bank was leveled. This leveling occurred in the mid-1940s. Tr. 3-13 and 22. The lake bank at issue was described as being a narrow strip, six to seven feet high, sandy, and so steep that a Model T could not be driven up it. Tr. 3-23.

A local contractor testified that he flattened-out an old lake bank on the north side of Lake Pulaski. In some places, it was about ten feet high. However, testimony regarding the old lake bank is not sufficiently detailed to draw any definitive finding other than it corroborates the feature at West Pulaski Park Tr. 4-194-196.

Primary Evidence: Other Marks on the Landscape

60. It was alleged that a cross-section roughy norths-south through the lake basin shows a wave-cut notch on the southern shoreline and a beach profile on the northern shoreline which, taken together, make it appear that the 1 976 water level, 958 feet, is the most natural "fit" for the lake's shoreline configuration. Ex. 520 at 56 and 93. There was insufficent evidence to support this allegation. It would appear that the allegation is based on the most recent U.S.G.S. quadrangle map and a 1970 Fish and Wildlife sounding map . However, there was virtually no discussion of this theory at the hear! ng, and the citations to it (Association Brief, p. 26) are inadequate to support it without further evidence.

primary Evidence: Soils

61 The last type of direct evidence regarding the OHWL of Lake Pulaski was evidence from soil maps and soil borings. Briefly, this evidence was offered based on the f act that if a lake mai ntains an level for a long enough period of ti me , it will change t he soils at the lake - I and interf ace (the shoreline). Through the use of soil borings at various elevations, it should be possible to determine whether the lake has been at any given elevation long enough to change the soils. Again, in the hypothetically ideal case, borings would be taken in a straight line perpendicular to the shoreline at regular intervals, such as one foot, so that the presence of beach soils could be pinpointed with some accuracy. For this hypothetical to be effective, however, the person interpreting the soil borings must be able to recognize the effects of water on the soils.

62 . Prior to making its 1981 determination of 968.8 as the OHWL, the Department took no soil borings. Indeed, the Department did not do any borings until the 1985 hearings were almost finished, and then only one person did some "scratching" with his finger and a twig, as opposed to a pattern of borings at regular intervals. Instead, the Department relied -upon a county soil survey prepared by the Soil Conservation Service. The Association, on the other hand, did perform a more sophisticated program of borings at different locations around the lake and at different elevations.

63. Between 1955 and 1961, personnel from the United States Department of Agriculture's Soil Conservation Service and the University of Minnesota's Agricultural Experiment Station did the field work for the Wright County Soil Survey. Ex . 38, Tr. 6-11. It is not known in what year, during that period, the field survey work for the area around Lake Pulaski was performed. This field work, combined with aerial photographs taken in 1965 or 1966, and a search of the geological literature and laboratory analysis, all were synthesized into a series of maps, drawn on a scate of 1:15,840. There are approximately 126 such maps covering the whole of Wright County. There was no testimony at the hearing from any of the persons who had actually participated

in the field survey work used to prepare the soil map for the area around Lake Pulaski. Instead, there was testimony from a state soil scientist employed by the SCS, who had experience doing similar field work and editing similar survey manuscripts. In addition, there was testimony from a retired University of Minnesota professor who had performed field soil survey work while an undergraduate, and had worked on a county soil atlas for a different county. Tr. 6-5 and 31. Neither, therefore, could testify with certainty as to whether the areas marked "beach materials, sandy" in places around Lake Pulaski were, in fact, identified by actual borings or other on-site investigations. It would not be unusual, however, for the boundaries of soils around a lake to be based on only two physical borings, such as one on one side of the lake and another on the opposite side. Tr. 6-37.

The SCS Wright County soil survey map for the area around Lake Pulaski shows areas marked "beach materials, sandy" around the northern edge of Lake Pulaski and around its southern and southeastern perimeters. The same conditions exist around most of the perimeter of Little Lake Pulaski. Superimposing these indications of beach materials onto the most recent U.S.G.S. quadrangle map (published in 1981) shows that such indications exist near, at, and in some cases above, the 970 elevation line. However, the accuracy of the U. S - G. S quadrang le map' s e Ievati on s are pl us or minus five feet . For that reason alone, the ref ore, such a procedure does not yie Id any satisfactory accuracy for purposes of determining an OHWL.

More impor tantly, however, the lack of a suffici ent number of on-site borings t hat wou Id ass u re accuracy in the preparati on of the soi I map makes it's use inherently unreliable. When added to the fact that the map does not distinguish between (1) sandy beaches artificially created by lakeshore residents who want a nice beach and (2) naturally occurring beach materials, indications of "beach materials, sandy" on the county soil survey map are not reliable indicators of the OHWL. See, generally, Tr. 6-16-17.

While the county soil survey may be valuable in areas which have not been substantially artificially altered or where there is no better evidence of soils available, in the case of Lake Pulaski, for the reasons given above, the county soil survey is of no value in determining the OHWL.

64. Dr. Hobbs, who has been identified earlier, went to Griffing Park and West Pulaski Park while the hearing was in progress in order to examine the geologic features there. In the course of his examinations, he did "scratch around" with his finger, and with a piece of wood. At the Griffing Park site he found that there was only a tiny layer (about one inch) of topsoil overlying boulders. He described this topsoil as "poorly sorted, but clean sand and gravel " Tr . 5-1 44 . He agreed with Mr. Leisch that the unusual shape of the top of the feature indicated an i ce rampart , bit Dr . Hobbs bel ieved that i f the rampart had been in existence for thou sands of years (since glaciation) the boulders would be overlain with top soil substantially t h icker , typically from six inches to one foot. Hobbs concluded that the ice

rampart was a moderate to young feature , formed wi thin the last 100 or 200 years, or even more recently. Tr. 5-146. More importantly , however, Hobbs concluded that the poorly sorted but clean sand and gravel which he found on the rampart in Griffing Park was a beach deposit. He differentiated the kind of beach deposit he found at Griffing Park from the very mature, clean, rounded, well-sorted and stratified sands that would be found in areas where water has been working on the soil for ten thousand ears. Tr . 5- 1 44 . In hi s opinion, both are beach deposits.

At Nest Pulaski Park, Hobbs "got his fingers dirty" digging in the geological feature, but did not take any formal borings. Based on other visual observations there, he described the soils in the area as till from the Grantsburg Sub-Lobe of the Des Moines Lobe. He found no beach deposits at West Pulaski Park. Tr. 5-143 and 150. The elevation at the top of the ice rampart in Griffing Park i s approximately 975 feet , wni le the elevation of the line of washed boulders in West Pulaski Park is 970.1 feet. There is such a variation in slope between the two, however, that had there been any beach deposits on the slope at West Pulaski Park, they would have eroded down the hi I I by virtue of wave action or surface water runoff . in fact, Hobbs testif led that the "finer stuff", sand and even some gravel had teen washed away down the steep slope. Tr. 5-143.

6 5 . In contrast to the soi 1 s data presented by the Department, the Association took soil borings, both on land and underwater, from six different

sites around the lake. The on-land borings were taken or attempted at Griffing Park on the southern shoreline; Dr. Leonard's residence on the northern shoreline; the Pulaski Shores area on the ncrtheas; shoreline; the West Pulaski Park area on the western shoreline; and the Goodale property on the northern shoreline of Little Pulaski. Underwater borings were taken at the Goodale residence on Little Pulaski, near the Bickley residence on the southeastern shorelineof the main lake, and at the West Pulaski Park site on the western shoreline. Ex. 520, pp. 65 and 70; Ex. 610.

From these borings, the Association concluded that the level of Lake Pulaski had not been any higher than 961 feet for a period long enough to create beach sands, and that there was absolutely no evidence of beach sands at an elevation of 968.8. Tr. 5-74-78. Ex. 520, pp. 67-72. However, there is an issue as to what Ms. Villas interpreted to be a "beach sand".

66. The Soil Conservation Service describes "beach material, sandy" as follows:

> . The soil material that makes up this land type varies, but it generally is dark-colored to moderately dark-colored coarse sand or loamy coarse sand and lacks distinct layers." (Ex. 38, p. 10).

It is formed by wave action, which washes up onto the shore and gradually sorts out the smaller sized materials and removes them, leaving the larger sized materials as the "beach". Tr. 6-13.

Ms. Villas, on the other hand, defined beach sediments to be:

> medium, coarse sands and gravels that tend to be well-sorted and rounded. There are some loamy coarse sands in there, and they are looser sediments.- That is they have not been, I'm talking about modern sediments or beach sediments that you would find today. They are loose, they are not consolidated, they have not been buried and compacted." (Tr. 5-80).

She stated that they are formed by waves winnowing out the fines, and leaving the sands in a layer from six inches to a foot. This would take a minimum of two to three years. Tr. 5-81-82.

The differences between the two def initi ons center around the depth of the deposit, the existence of gravel, and rounding. Particles are rounded by the continuous force of wave action rubbing them against one another. It is noteworty that both definitions include some loams. All of the factors differentiating the two definitions are factors of time. The longer the time that wave action acts on soil particles, the more rounded they will be, the more thorough the sort ing of f ines (resulting in more gravels and less foams the greater the depth, and the greater the compaction. Clearly, if a lake rises up to any given level and only stays there for a year or two, there will be much 1 ess sort ing and round ing at t hat 1 eve! than wou Id be the c ase if the lake stayed there for a hundred years. If the lake stayed at that same level for hundreds or thousands of years, then the depth, compaction, sorting and rounding would be even more complete. (Tr. 5-144).

The Association's soils expert, Ms. Villas (whose qualifications have been described earlier) testified that she found no beach sediments, which met her definition, at any elevation above 961 feet. The borings which she interpreted to include beach sediments were identified as a boring taken 50 feet lakeward from the shoreline on February 21, 1985 at a location "south of Bickley's, southeastern shoreline". This boring encountered beach sands at approximately 960.8 feet. Another boring, taken at 20 feet lakeward from the shoreline on February 22, 1985 at Buffalo Park (West Pulaski Park) along the western shoreline located beach sediments at an elevation of approximately 961 feet. There were a total of approximately 20 different borings taken at different sites, including both those taken on land and those taken through ice. Of those 20, the two borings noted above were the only ones which encountered beach sands, as defined by the Association.

The description given to these two borings were, for the Bickley boring, .coarse, poorly sorted sand". For the Buffalo Park boring, it was described as "brown silty medium to coarse sand [underlain by] brown coarse sand and gravel, few fines [underlain by] green silty medium to coarse sand and gravel." (Ex. 520, pp. 69 and 70).

Contrast these descriptions with what Dr. Hobbs described at the top of the ice rampart at Griffing Park: "Poorly sorted, but clean sand and gravel." (Tr. 5-144). The top of the ice rampart at Griffing Park has an elevation of approximately 975 feet. There is no evidence that the lake has ever been near that elevation within the relevant time period.

67. Moreover, a review of the descriptions accorded to other borings which were not identified by Ms. Villas as beach deposits are not clearly different from those which she did identify as beach deposits. For example, at Griffing Park, on-land borings 30 feet landward from the shoreline in late July of 1984 disclosed a layer of "fine to coarse sand with some gravel" at elevations between 965.7 and 962.7. Borings taken even closer to the lake (10 and 20 feet from the shoreline) showed "poorly sorted fine to coarse sand and gravel under a thin layer of topsoil." At the same site, 100 feet from the shore, at an estimated elevation of 965.3 to 963.3, there was identified "silty sand with some clay and gravel". Ex. 520, p. 65. While deference must be given to the qualifications of both Villas and Leisch in identifying beach deposits, the inadequate explanation given of the difference between the two does not

allow much weight to be accorded to the Association's conclusion that what was found at 961 was a beach deposit, but what was found at 965 was not. While common sense (and actually recorded lake levels for the few years that they are available) suggest that it is more likely than not that those two experts are correct in their conclusions, not as much weight is given to them as might be the case if they had been better explained and, in addition, if there had beer more borings showing the same result. The logic behind using beach deposits as evidence of the OHWL is frustrated when they are not found fairly uniformly around the lake at roughly the same elevation.

Secondary Evidence - Aerial Photoqraphs

68. Aerial photographs of the Lake Pulaski area taken in 1937, 1940, 1953, and 1975 were analyzed and interpreted by Morris Eng, a Department Hydrologist with 28 years of experience in reading and interpreting aerial photographs. Tr. 3-77.

For purposes of this report, the most important set of photographs are three photographs taken in September of 1937. Ex. 25A, 25B and 25C. Using a stereoscope to look at two photographs at a time, a three-dimensional view of features can be seen. Along the southeast and northeast shores, Eng discerned a succession of former shorelines. He noted eight separate lines. The highest watermark identified by Eng was located below the hardwood tree line. Development around the lake was generally located above the dark-toned hardwood tree line. That portion of the road around the south shore immediately east of the sharp "S curve" is located approximately 20 feet from the highest visible watermark. This watermark can also be seen on the 1940 photographs, most clearly on Ex. 537, which is an enlargement of the smaller photo.

What is most notable in the 1937 photographs about the area just east of the sharp S curve is the virtual absence of any vegetation between the road and the lake. There is a definite line of trees on the south side (upland side) of the road in this area, all along but there are virtually no trees between the north side of the road and the lake. This can be seen with the naked eye and more clearly with a magnifying glass, in Ex. 25B and 25C. It is easiest to see in the blown-up copy of 1940, Ex. 537.

There is a large-scale (I" - 100 feet) map which was prepared from aerial photographs taken in 1975 and 1978, which shows elevations in two foot contours. It can be used to estimate elevations to a greater degree of accuracy than the 10-foot contours available on the various U.S.G.S. maps. This map was marked by Mr. Eng to show the area of the road east of the sharp S curve, where he noted the highest watermark to be on the 1937 photographs. The map, itself, gives elevations of the road in the area marked by Mr. Eng which vary between 971.6 and 973.4.

69. The road in this area has, however, been changed, but only slightly. Prior to the late 1950s, it was an unplatted cartway. At some time, it was tarred and maintained by the property owners whom it served. In 1953, it was "just about the condition of gravel even though it might have had some asphalt on it . . . a very narrow road". Tr. 5-45. In the late 1950s, the road was made into a two-lane tarred road by the county. During this process, however, the road was raised only by a marginal amount, approximately 2". Tr. 3-25. Then later, in the early 1970s, the City of Buffalo (which had annexed the area in 1970) ripped up the road to place sewer and water lines down its center. During this construction, the road was raised a bit. Tr. 5-46. But there is no evidence as to how much it was raised. A long-time resident, however, believed that it had not been raised or lowered by any substantial amount since his recollection began, which was in the early 1920s. Tr. 3-10 and 25. It is specifically found, therefore, that at least in the area which is circled in green on Exhibit 29, the road continues to be a reliable landmark whose elevations may be used in conjunction with photographs and

other evidence (to be presented below) to determine past lane levels. There is, of course, some inaccuracy due to the sewer and water construction's raising, but it is found that this is not more than one foot.

Eng stated that his examination of the 1937 photographs placed the highest watermark approximately 20 feet from the road. Using the scale on Ex. 29, 20 feet from the centerline of the road gives an elevation of approximately 968 feet. This varies, however, within the area marked by Eng, from 971 down to 967. His observation from the aerial photographs, therefore, provides only a rough estimate of the highest watermark which he observed. It is, nonetheless, of assistance.

Secondary Evidence: Pitching Peanut Shells from the Road

70. Another important bit of evidence regarding the road near the Randel Farm comes from the testimony of a 74-year-old resident who has lived within a half mile of the lake all his life. He recalls that he and his brother threw peanut shells into the lake from a wagon while the wagon was on the road at that point. He stated that they could throw the peanut shells into the water in the early 20s. Tr. 3-10 and 12. He believed that the lake was approximately three feet higher at that time than it was at the time of the hearing. At the time of the hearing the elevation was 965.6. His recollection, therefore, would have placed the lake at approximately 968.6 in the early 1920s. While there can be no great accuracy placed on a person's recollection of events 60 years ago, this testimony does tend to support the elevations derived from the aerial photographs analyzed by Mr. Eng.

Secondary Evidence: Wall Around Tree

71. As was noted earlier, there is a concrete block wall built around a tree which is presently located on the property of R. G. Torbert. The base elevation of the tree is 968.7. Tr. 3-49. A long time resident recalled a former lake bank as being up to where the tree was and that the wall was constructed in order to prevent the tree from falling over when the bank was leveled. Tr. 3-13. He recalled that the water level "came up pretty close to the tree" in the early 1920s. Id. A reasonable estimate of the elevation of the lake based on that testimony would be 968.0-

Secondary Evidence: The Coulter Wall

72. On the eastern shore of the lake there is a long rock wall. It can be

seen most clearly in Ex. 6, p. 35 (top photograph) and Exs. 636, 637 and 638. The wall, however, is not at a uniform elevation. Tr. 5-73. The average top elevation of the wall is 968.9, and the average toe elevation is 966.1. The wall is approximately 225 feet long. Tr. 1-96. A ong-term resident of the lake recalled that the "water came up through" the wall in the early 1920s. Tr. 3-11. That would place the water elevation somewhere in the range of 966.5. There are, however, sections of the wall where the bottom is lower than that. For example, Ex. 636, taken when the lake was at approximately elevation 965, shows the water up to the bottom of the wall.

There is no evidence in the record to prove (or disprove) the theory that the elev ations of the wal I can be coordinated with the elevati ons of the lake when the wall was built. It has been suggested that the wall was a shoreline protection device. it has also been suggested that the wall is nothing but a randomly-placed pile of stones which were removed from lower elevations in order to clear the land for a beach. It is more likely than not that the wall is a retaining wall, but there is no way to determine an OHWL from the mere existence of the wall. It's placement, therefore, is not of assistance in determining the OHWL.

Secondary Evidence: The Melgaard HOmE

73. Gerard Melgaard has lived in Buffalo since 1953, and on Lake Pulaski since 1967. Tr. 5-28 and 36. His home is located on the southern shore of Lake Pulaski, immediately to the west of the "S curve" in County Road 114 described earlier. It is in an area known as Pulaski Beach. The plat for Pulaski Beach was filed in 1893. Ex. 602-G. Melgaard's home was built between 1911 and 1913. The bottom of the footings underneath the basement are between 966.9 and 966.6.

It is reasonable to assume that the persons who built the Melgaard house would not have dug a basement and placed footings at the range of 966.9 to 966.6 if the lake had been at or near that elevation within their memory. The then-cwner of the lot, Charles Shatter, first acquired the property in 1908. Ex. 602-G.

74. Mayor Melgaard also caused a survey to be made of his property in March of 1985. The purpose of this was to determine what the lake elevation was in 1893, when the property was platted. In 1893, the county surveyor p I aced four iron posts when p latting the Pulaski Beach subdivis ion. In 1985, when Melgaard caused the survey to be performed, those posts were not used. Instead, the surveyor worked from "lines of occupation and usage" (current property lines). Tr. 5-53. Based upon those lines, the surveyor determined the boundaries of the lot as platted in 1893. Using those boundaries, it was determined that the lake must have been at 959.9 in 1893. [The testimony was 959.4, but there appears to be a mathematical error in that calculation, as the water level was at 965.63 and the original boundary was determined to be 68.5 inches under that water elevation. 68.5 inches equals 5.71 feet which, when subtracted from 965.63, yields 959.92.]. While the use of the original stakes would have been preferable, it is reasonable to assume that if the plat was accurate in determining the distance between the front of the lot and the lakeshore, then the lake must have been in the area of 960 in 1893.

Secondary Evidence: Other Recollections of Lonq-Term Residents

75. There were a number of persons who testified as to their recollections of the area of the channel between Lake Pulaski and Little Pulaski at various times. However, because the record clearly indicates that this area has been artificially disturbed on numerous occasions, with no evidence of restoration to original elevations, such testimony is not valuable in attempting to establish prior lake levels.

7 6 A woman who has been swimming in the lake since 1926 testified that she had "never seen the lake this high." Tr, 2-41. Her husband's family moved to the lake in 1915, and she does not recall either him or his family (which had lived there longer) ever commenting on high water. Tr. 2-43.

77. The record, particularly the evening hearing which is transcribed in volume 2 of the transcri pt , is replete with testimony from persons who have come to the lake in the 70s, the 60s, the 50s, the 40s and even the 30s, to the effect that the lake was never as high as it is now. It is clear from the weight of all of the testimony from citizens who have seen the lake over the years that from at least 1935 onward, the lake has never been as high as it is at this time. See, generally, Tr. 2 and 4-177.

Secondary Evidence: Old Postcards and Other Photographs

78. At some point prior to 1900, a hotel and a couple of cabins were built on the east-southeast shore of Late Pulaski. A 1901 plat book identifies this location as the "Pulaski Hotel". Ex . 550. It is the area colored red on Ex. 570. In approximately 1900, the hotel and the land were purchased by a Frank Bannochie. Frank Bannochie's grandson, Joseph Metzger, provided an explanation of the development of the property, and analyzed a number of photographs and postcards that assist in estimating water levels from the turn of the century to 1923.

79. The hotel building, marked as #3 on Ex. 15A and I5C, and depicted on postcards 571A, 571B and 571C, is no longer standing. It was destroyed by fire in 1923. Ex. 551. The Department had been told by an unnamed person that a new structure, depicted as #8 on Ex. ISD, had been built on the same site as the old hotel building. That, it turned out, was erroneous information. However, based upon that information, the Department had estimated the lake's elevation as 964 in 1910. Tr. 1-194-195.

80. The old postcards do, however, depict a building which is still standing on the same location as it was at the time of the postcards. This is the building marked #7 on Ex. I5A, I 5B and Ex. 572. Tr . 4- 1 5 .

The photographs in Ex. 15A and 15B are taken from a large picture postcard, which is in the record as Ex. 571A. This postcard is undated. However, the caption on the card is "Lake Pulaski Hotel". Subsequent postcards, which are dated, are entitled "Bannochi(e) Summer Resort". It is logical to assume, therefore, that the large postcard, bearing the earlier name, was printed before the name was changed to Bannochie. That would put it around 1900. That same postcard shows cabin #7, which has been identified as still standing at the same location. It is presently owned by W. Angler, and has a ground elevation of 965.8 and a walkout elevation of 966.3. Ex. 541, photograph (52) #107. It has a basement, but there is no evidence regarding the depth of the basement.

Although a witness estimated that the water level in the 1900 photograph

was the same as the water level shown in Ex. 572, taken in the summer of 1984,
the Judge cannot agree. The water level in the photograph is much lower than the 1984 water level. The summer of 1984 level has been estimated to be

approximately 965.0. The 1900 photograph shows the lake approximately four feet below the 1984 elevation, which would put it at 961.0.

81. Although the 1 900 postc ard , Ex. 57 1 A, is undated, there is another postcard, Ex. 571C, which bears a postmark of 1910. The postcard was printed in Germany. It is reasonable, therefore, to assume that it depicts conditions no later than 1908, and earlier. The lake Ieve I in t hat postcard is approximately the same as it was in the 1900 postcard, 961.0.

82. There is a photograph, Ex. 573, which includes Mrs. Helen Bannochie Metzger and two others standing on a dock, with cabin #7 behind them. It was taken in 1914 or 1915. Obstructions on the photograph prevent any precise estimation of the water level , but i t appears to be approximately where it was in the 1900 photograph, although it may be a bit (one foot ?) higher.

83. From all of the above, it is found that the Department's 1910 estimate of 964 plus or minus (Tr . 1-194-195) is too high by a factor of approximately three feet, and that the lake's elevation in 1900 and 1908 was about 961 .0. The elevation in 1914-1915 was approximately 961-962.

Secondary Evidence: The Fredell Letter and the Frellsen Memo

84. In 1953, Game Warden Glenn Fredell indicated that property owners were suffering considerable damage due to high water. He went on to state that as late as 1929, the water was at least two feet higher than it was in 1953, and that between 1918 and 1919, the water was about five feet higher than it was in 1953. Ex. 22.

85. Department personnel used 1953 aerial photographs to estimate the water's level to be between 961 and 962 in 1953. Tr. 3-62-63. If the Fredell estimates were correct, then the level in 1929 wou Id be 963-964, and the level in 1918-19 would be 966-967.

86. In 1960, Sidney Frellsen, then Director of the Division of Waters suggested that the elevation was 960 in 1953. However, that is based upon the 1958 quadrangle map, which states on its bottom that it is based upon aerial photographs taken in 1953. During the 1985 hearing, the actual aerial photographs which were used to prepare that map were introduced into the record as Ex. 27A-27E. They show that the elevation of 960 on the map was not based upon those 1953 aerial photographs, but was rather based upon an actual

reading taken in 1957. This was explained by Mr. Eng at Tr. 3-86. Therefore, any interpretation of Frellsen's 1960 memorandum which suggests that the lake was at 960 in 1953, is incorrect.

87. What we are left with, however, is the Fredell memorandum. There is no indication in the memorandum itself, or anywhere else in the record, as to how Fredell arrived at his estimates. Without further foundation for those estimates, they are accorded only minimal weight.

Secondary Evidence: Winchell-and Upham

88. Between 1882 and 1885, N. H. Winchell and Warren Upham prepared a document entitled The Geolog, of Minnesota, which was printed in 1888. In

connection with an analysis of soils encountered during well drilling in Wright County, the following statement is made:

> "Buffalo. E. Richards; in section 20, some 20 feet above Pulaski Lake, well, 27 feet [deep]

89. The earliest plat map in the record is a copy of a 1901 plat book which is reproduced at page E-7 of Ex. 6. The only "Richards" shown in section 20 is a J. H. Richards, who owned land abutting anc south of the lake in the western half of the section. This land crosses the half-section line, and is in both the northwest quarter and the southwest quarter of the section. Later plat books show that J.H. Richards had moved to the far eastern edge of the section (1915). Ex. 546; 1927-28, Ex. 529 and 570. The 1901 plat map does not, however, show a house on the "J. H. Richards" property. It does show a house to the east of that, on the property of "A. Flamount". This house is just west of the half-section line, placing it in the northwest quarter of the section. The Department assured that this house must be the same house as is presently owned by David Randel. It proceeded to measure the elevation of the well presently on the Randel property, which was at 986. It subtracted 20 feet from this figure to reach its estimate, for 1882-1885, of 966.

90. The Department's witness admitted, however, that he was only guessing that it was the same well, and that he had no idea how the "some 20 feet" was measured (or whether it was only a rough estimate). Tr. 1-187. It is found that there are too many assumptions built into this estimate to give it any weight.

Secondary Evidence: 1858 Meander Line

91. In 1858, a survey of the county was made by the Government Land Office. A copy of the survey map is contained at page E-6 of Exhibit 6. An enlargement of the map is shown at page 20 of that exhibit. When the outline of the lake from the 1858 survey was put to the same scale as the 1981 U.S.G.S. quadrangle map, and then superimposed on it, it showed that the outlines drawn in 1858 fit between the elevations 960 and 970. The Department, therefore, took the average between those two, and estimated the 1858 elevation at 965 plus or minus five feet. The uncertainty of this estimate, coupled with the ucertainty which must be accorded to the surveyor's work itself, renders the estimate meaningless in setting the OHWL.

Secondary Evidence: Development Patterns

92. There is a general trend in the elevations at which homes have been built over the years around Lake Pulaski. However, there are a number of

factors which must be taken into account when considering whether or not this trend supports a theory that the water was high in prior years.

93. A study was made of records contained in the Wright County Assessor's office to determine when each of the pre-1950 houses around the lake was actually built. The Assessor's records contain, for some houses, an estimate of when they were built. This estimate is based upon an assessor's evaluation

of how the house was built or, in some cases, actual dates of construction.
Tr. 1-167-172.; Ex. 6 pp. E-1-E-5.

These estimates of age were then matched with elevations as determined by the Corps of Engineers during their 1983 survey of homes around the lake. Ex. 521. The combined data was then analyzed with a view to determining whether there was any correlation between when people built and the elevation at which they built.

Of the 48 structures thought to have been built between 1900 and 1930, only five are presently located below an elevation of 969.0 Three of those five were built in 1930, when lake levels were thought to have been dropping, and the other two were allegedly moved closer to the lake after levels dropped. In comparison, between 1931 and 1970, there were 84 structures thought to have been built. Of those 84, 52 were located below 969.0. It can be stated, therefore, that the vast majority of the structures built between 1900 and 1930 were located above 969.0, while a majority of the structures built between 1931 and 1970 were built below 969.0.

From this data, the Department argues that its theory that the lake level was near 969.0 sometime before 1930 is substantiated. A local resident, however, offered another conclusion: that the development pattern reflects building by persons from the City of Buffalo, and that the closest part of the lake for them to build on was the west and southwest shore. He reasons that since there are higher banks on the west and southwest shores, and since the road that those people would use is built on the top of the bank, the earliest builders built their homes on top of the bank to avoid havirg to go up and down steep slopes in order to get to their homes. Tr. 3-60-62. A comparison of the contours on the U.S.G.S. quadrangle map and the location of houses bears out this theory in some places, but not others.

94. It is concluded that the Department's theory, that the difference in elevations between houses built before 1930 and those built after 1930 is related to lake elevations, has some merit, but that there are so many exceptions and other explanations (such as the road's placement or a high bank) that it is far from dispositive. For example, one of the earliest structures on the lake was the Pulaski Hotel, renamed the Bannochie Resort. It was located between the road and the lake. Between 1900 and 1915, at least two cabins were placed at approximately 965.0. Those cabins would not have been placed there if Frank Bannochie thought they would be flooded. Tr. 4-127-129; Ex. 568 and 572. Another example is the Melgaard home, built

during the same period, with basement footings below 967.0. Such exceptions, however, do not completely vitiate the validity of the general theory. But there are enough of them that not much weight can be given to it.

Causes of Recent High Water Levels:_Precipitation

95. As noted earlier, numerous residents testified to the fact that the lake has never been as high as it is now. Some of their recollections, some of which stretch back into the 1930s and 1920s. There are hundreds, if not thousands of dead and dying trees in the water, some of which are clearly 50-60 years old. The residents around the lake ask why the lake is so high now. As will be explained below, there is no single answer. Instead, there are a number of factors which are contributing to the current water levels.

96. The first of these factors is precipitation. All parties agree that participation is an important factor. Tr. 3-114 and 5-106.

97. Precipitation data from Buffalo is only available on a year-round basis since 1951, and on a partial basis since 1948. However , data is available from Maple Plain going back to 1882. Data is available from the Minneapolis-St. Paul station on a year-round basis from 1837. Using 10-year running means, it can be seen that the Buffalo data which is ava i Iab 1 e reasonably approximates, at least in trends, the Maple Plain data. Ex 6 , p. A-4. The Buffalo data also approximates, but with a less-accurate "fit", data from Minneapolis-St. Paul. Id. Looking at the data which is available, on a 10-year running mean basi s , i t can be seen that there are 1 ong-term cycles, or trends, in rainfall . There was a generally dry per iod around 1 855, rising to a wet period around 1875, fol lowed by a dry period around 1890, followed by a long rise to the wettest period on record arcund 1910, followed by the drought centered in 1937, followed by a moderately set period around 1958. Those dates represent the center dates of the 10-year running means, so they are not the exact center dates for the major trends. Ex. 6, p. A-3.

Looking at Buffalo, where ful I year actual data i s avai I able from 1951 onward, the average precipitation from 1951 to and including 1984 was 29.26 inches . However , looki ng at just the I ast ten years , from 1 975 to 1 984, six of the years were above that average , whi I e four were below, i t . Looking at the I ast f ive years from 1 980 to 1 984 , three of the years were above average and two were below. The f igures for the I ast five years were as fol lows : 1980 - 24.00; 1981 23.97; 1982 - 35.03; 1 983 - 33.35; and 1984 - 32.43. Ex . 6, p. A-5. The two-year period of 1982 and 1983 was the second wettest two-year period on record, exceeded only by the two years of 1 951 and 1 952

The 1982-1983 winter season produced an unusually large amount of snowfall. Melting snow creates more runoff than an equal amount of rainfal I , because the frozen ground cannot absorb it, and because evapotranspi ration during winter periods is virtually zero. Tr. 5-113-1l4.

98 . The parties agreed that lake levels generally tend to follow precipitation trends. Tr. 3-128 and Ex. 520, p. 41.

9 9 . Without be I abor i ng the point any further , i t i s spec i f ical 1 y found that one cause of the recent high water levels is higher than average precipitation, particularly snowfall. But preci pi tat i on patterns alone can not fully account for the recent levels.

I 00 . In addi t ion to us i ng prec i pi tat ion data to explain recent lake I eve I s , both parties attempted to use the precipitation data to support their theories of what past lake I eve I s must have been in certain years these efforts, however , are unsat isfactory , because the Buffalo data onl y goes back, to 1951. The efforts ware made based on Maple Plain or Twin Cities data. While, in a gross serse, it is appropriate to use those records to identify long term trends at Lake Pu I ask i , there i s too much vari ati on in individual years to give credence to using them for specific earlier years.

Causes of Recent High Water Levels: Underground Water Levels

101. The Department analyzed 27 water wells in the vicinity of Lake Pulaski which had been drilled between 1975 and 1983. It compared the water level in each of the wells at the time it was drilled with the water level in February of 1985. In the vast majority of cases, the water level had increased. Grouping the wells into eight groups (depending on when they were drilled) shows that on average, the wells drilled in each year from 1975 to 1983 had increased in water level by February of 1985. Ex. 6, p. G-12 and Ex. 35.

102. The Department also looked at three municipal wells maintained by the City of Buffalo. These are deeper than the wells around the lake discussed above. While each of the City wells shows a slightly different pattern, it is found that there has been a dramatic increase in levels at those wells between 1983 and the start of 1985. For the two wells that have data going back several years, the 1984 and 1985 levels are higher than any previously recorded levels. However, none of the wells goes back earlier than 1968. Ex. 34.

103. The parties do not disagree, basically, about the water levels in these wells. They do disagree, however, on the question of whether ground water is flowing into Lake Pulaski, and thus contributing to the recent high water problems, or is flowing out of it, thus mitigating the problems (and causing the higher well readings).

104. Lake Pulaski is a relatively deep lake. Its maximum depth, as measured in 1970, was 87 feet. By the time of the hearing, its depth had increased to approximately 94 feet.

105. Both parties attempted to estimate the net contribution (or diminution) resulting from ground water inflows (or outflows) from the lake. They did this by using the concept of a water budget, which has a number of components arranged in the form of a formula, and attempting to use measured or estimated values for the other components in the water budget formula to arrive at an estimate of the ground water factor. However, the only elements of the formula which are known with any certainty are the change in water levels over a given period of time (which can be calculated precisely from gauge measurements) and precipitation falling on the lake (which can be calculated from precipitation data and the size of the lake itself). The remainder of the elements in the formula had to be estimated. These elements included the amounts of watershed runoff and evaporation. Both parties' experts admitted that the assumptions that have to be made in this procedure render the outcome highly dependent on changes in those assumptions, and in fact, both gave examples of how their results would change depending on what assumptions were used. Both agreed that there were more accurate ways to solve the problem, but that deriving the necessary data to use the more sophisticated methods is prohibitive in both time and money.

106. There is, however, another method to determine whether or not a lake is dominated by ground water. This is done by chemical analysis of the water, and comparing it with values in the literature. While this method can classify a lake into "perched lake", "transitional lake", or "groundwater

lake'', it does not permit any quantitative evaluation of ground water's influence.

Lake Pulaski is dominated by ground water. Measurements of conductivity, calcium, magnesium, and hardness, all exceed those considered to be re presentative of a lake situated in this type of glacialti I 1 and known to be dominated by more than 50% ground water. Tr. 4-76-77.

Causes of Recent High Water Levels: Increased Surface Runoff

107. Part of the water budget calculation referred to above requires an estimate of the size of the watershed which contri butes water to the lake, and the runoff co-efficient. Given the same amount of precipitation and the same runoff co-efficient, a larger watershed area would contribute more water to a lake than a smaller watershed area. On the other hand, if the size of the contributing watershed area is held constant, and the precipitation is constant, the amount of water going into a lake will vary with the runoff co-efficient. The Association argued that both the size of the contributing watershed for Lake Pulaski has increased, and that the runoff co-efficient for the contributing area has also increased, both as a result of artificial changes in the contributing watershed.

108. There can be no question but that drainage ditches, tiles and culverts, roads and streets (including some with storm sewers), commmercial and residential structures and associated facilities with impervious surfaces have both increased the size of the contributing watershed and the velocity and quantities of surface water which flow into the lake. Water which previously was stored in marshes, ponds and sloughs, and diminished by evapotranspiration and infiltration is now contributing to the water level of Lake Pulaski.

A field survey in April of 1985 disclosed at least 12 artificial drainage features which empty into the lake along the eastern and southern shorelines. These include culverts, drain tiles and drainage ditches. Ex. 520: 51-54. In addition, Victor Corron, a local contractor, identified two drainage ditches which he constructed on the lake's east and west shores. Tr. 4, 178 and 182.

The existence of these ditches, culverts and other devices was confirmed by many of the local witnesses, and some of the more notable devices were viewed during the March 27 site visit. Tr. 2-28 and 37, Tr. 4-91-93 and 207-212: Tr. 5-12-14, 21-22 and 58-59; Ex. 528 and 588, 595-599, 60OA-F, 683-687 and 690-698.

1 09 . Whi I e there are no quanti tat ive esti mates of the tota I amount of water contributed by all of these devices, there is an estimate of the quantity from one of the most obvious of them, the "How Ditch". This ditch drains a large area east-northeast of Little Pulaski into Little Pulaski. On March 20, 1985, drainage from the ditch into Little Pulaski was estimated at a rate of 20 cubic feet per second. Tr. 5-183. The actual acreage which now drains into Little Pulaski as a result of this ditch, but which would not have drained into the lake except for the existence of the ditch, has not been accurately

established. Within the last two years, a ridge was cut down to permit a large slough to be emptied into the How Ditch. Tr. 4-208-209. A rough estimate of the total acreage now drained by the How Ditch can be made, however, by looking at the green lines on Ex. 588.

110. A number of farms, including the How farm already mentioned, have been tiled and ditched so that their surface and subsurface waters flow into Lake Pulaski. These include the Klatt farm, the Ordorff farm, the Randel farm and the Esterly farm. Again, however, no reliable estimates of total quantity are available. Tr. 3-109-112; 4-180, 191, 209-211; 5-7-9, 96-97; Ex. 528 and 588, 596-599, 60OA-F, 681, 682, 685-687 and 690-695.

111. In approximately 1910, Rice Lake, which is located to the south of Lake Pulaski, was drained into Lake Pulaski. The area in which this lake was located continues to be drained into Lake Pulaski by tiles running through the Esterly and Randel farms. Tr. 4-122-123; Ex. 526, 529 and 599.

112. There have been a number of major residential and commercial developments constructed around Lake Pulaski, most in recent years. These include the Douglas Addition (1972 to present), Myhran Park Estates (1980 to present), a mobile home park to the south of the lake (1963-64), the new Buffalo Hospital (1981), the new clinic (1980), the new high school (1973), the Wright County Vocational School (1973), Functional Industries and a church to the west of Lake Pulaski, the Wright County Historical Building, and the Highway Department Building (the latter two being to the west of Lake Pulaski). In addition, there has been substantial housing construction all along the shores of the lake, and there is a housing subdivision known as Pulaski Shores at the northeast corner of the lake. All of these developments have contributed an unknown quantity of water to the lake. Some of this is obvious above ground, in the form of surface ditches and culverts which can be seen, while other portions are in underground tiles. Storm :ewers, for example, flow into the lake from the Douglas Addition via underground tile.

Some of the developments have displaced marsh or pond areas where surface water used to be stored. However, the amount of storage, evapotranspiration and seepage which has been eliminated by these features cannot be reliably estimated.

Causes of Recent High Water Levels: Summary

113. Precipitation, ground water and increased runoff due to drainage and

development are all contributing to recent high water levels. However, there is inadequate data in the record to compute the relative contributions of each of these factors. It is certain that each of them has contributed to the high water levels, but attempting to quantify those contributions cannot be done on the basis of the evidence in this record.

Based upon the foregoing Findings, the Administrative Law Judge makes the fol I owing:

CONCLUSIONS OF LAW

1. Any of the foregoing Findings of Fact that are more appropriately considered Conclusions of Law are hereby adopted as such.

2. All relevant substantive and procedural requirements of law or rule have been fulfilled, and the Department and the Administrative Law Judge have jurisdiction over this proceeding.

3. The appropriate definition of the term "ordinary high water level" is that set forth in Minn. Stat. 105.37, subd. 16 (1984).

4. Each party advocating a specific number as the proper OHWL for Lake Pulaski has the burden of proving, by a preponderance of the evidence, its proposed figure. Neither the Department, which advocated 958.8, nor the Association, which advocated 961.4, has sustained that burden.

5. The Administrative Law Judge has no authority to de:ide the constitutional issues raised by the Association.

Based upon the foregoing Findings and Conclusions, the Administrative Law Judge Makes the following:

RECOMMENDATION

It is recommended that the Commissioner establish the ordinary high water I eve 1 of Lake Pulask i , Wright County, at 967 . 5 feet above sea I eve I, Nationa I Geodedic Vertical Datum, 1929.

Dated this 26th day of August, 1985.

ALLAN W. KLEIN
Administrative Law Judge

NOTICE

Pursuant to Minn. Stat. 14.62, subd. 1, the agency is required to serve its final decision upon each party and the administrative law judge by first c1 a s s ma i I .

Court Reporter: Janet R. Shaddix & Associates

MEMORANDUM

I.

The recommended OHWL, 967.5, is based upon a weighing of all of the evidence in the record. As noted in the Findings, some of the alleged facts have been accepted in their entirety. Other alleged facts have been rejected in their entirety. Still others have been given some weight: they were not either totally accepted or totally rejected.

The most important facts leading to the recommendation are the following:

1. The only trees which were proven to be more than one hundred years old were the five identified by the Department (with reduced elevations between 969.55 and 970.17) and the Leonard Elm identified by the Association (reduced elevation of 965.67). The Leonard Elm, however, is flawed by its distance from the lakeshore and the uncertainties of the elevations behind it. All of the other trees which were bored are less than one hundred years old, ranging from 31 years old to 74 years old. The oldest of those, the How oak and the Carpenter/Poirier cottonwood, have questionable locations. The ages of the trees with unquestioned locations are from 31 years old to more than 60 years old. These are simply too young to rely upon.

2. The aerial photographs from 1937 and 1940 show no significant vegetation below a range of 971 to 967. These photographs are supported by the recollection from the early 1920s of the lake's elevation at that time.

While it should be obvious from the Findings -that there are numerous other factors which were considered, the ones mentioned above were the most important.

The setting of an OHWL is not a precise science. For example, the methodology adopted by both the Association and the Department involves an averaging of a number of figures. And even those figures are based upon a judgment call of which trees to include in the average. Despite the fact that the OHWL defines important property rights of landowners on a lake or river, there is no pre c i se method for c alcul at i ng it, as has been noted by the author of the leading article on the subject, as follows:

"It would seem that something as basic to the determination of property rights as the method for establishing the boundaries of lands bordering navigable inland waters would be more than well-settled in the law. In most states and in the federal system the ordinary high water line (OHWL) is the boundary between privately-owned riparian uplands and publicly-owned soveignty lands beneath ron-title

> navigable waters. Ironically, the determination of the OHWL Is as confused as it is important. (Footnotes omitted).

Maloney, The Ordinary High Water Mark: Attempts at Settling an Unsettled Boundary_Line, 13 Land and Water Law Review 465 (1978).

III.

Determining the time period which will be given most weight in examining the various pieces of evidence is an important judgment factor that deserves explanation. For example, if the only relevant evidence is that which has been left on the landscape for the last ten years, there would be a far different result reached. If the time limit were set at the last 50 years, there would be a different result. If, on the other extreme, there was no time limit, then the result would be still some other number. The time period selected has a definite impact upon the final number arrived at.

For purposes of determining the OHWL on Lake Pulaski, the time period selected is roughly 150 years. This has been done because it represents the outer boundary of certainty when dating evidence. It also represents a balance between protecting the rights of private landowners and the rights of the public to the state's waters. Selecting a very long time period (such as 10,000 years) would unfairly deprive private landowners of the right to use their land free from state regulation. On the other hand, selecting a very short time period (such as ten years) deprives the public of the use and enjoyment of public waters. While there is no statute or rile that uses the term "150 years", Lake Pulaski is a good example of why it is necessary that some reasonably large number be used. As noted in the Findings, there are hundreds of trees dead or dying in the water. These trees germinated and grew during the past 50-60 years, when the lake was at lower elevation. If 50 years were used as the cutoff point, then the ordinary high water level would be set at a much lower figure, at or near the 961.4 recommended by the Association. But the high waters which have existed for the last few years, and continue to this date, demonstrate that such a figure would be too low. Although the Wright County zoning ordinance is not in the record, a typical zoning ordinance allows a landowner to build a permanent structure on his property so long as the lowest floor elevation is at least three feet above the highest known water level. If 961.4 were used as the highest known water level, it is obvious that persons who complied with that requirement would nonetheless be in trouble today.

Reasonable people could certainly differ over whether 150 years is the proper time period to use. Some might argue for a longer period, while others might argue for a shorter one. The Commissioner is encouraged to consider this question, and perhaps even establish a time period by rule so that there is some certainty for future cases.

A . W . K .

APPENDIX A

TABLE 1.

Age ESTIMATES
OF TREES BORED AfFTIEUR I!EAPING

BORING PROPERTY DIAMETER (DBH)
ELEVATION REDUCED AGE
PER AGE PER AGE PER
ID OWNER &
TYPE OF BASE ELEVATION
STOFFEL GREILING ROBINSON'

2A How 5 5.
5", 969.)8 2
(4.625) -,lo 75 + 2
74
Red
Oak 964.56

2B Carpenter 38.
4" 964 . 95 (I . 6)
6 1 68 C)g+l
("a Po i H e 0
C&to"ood 96 3. 35

2C S t r i e f f 48
" 965. 3 (2
) 62 04
61 min."

Cottonwood 963.3

2D Strzok
39.5" 964,472
(1.65) 56 99
59
(aka Setterberg)
Cottonwood
962.82

2E Loberg
31.3" 963.482

(1.30) 53 70
60

Cottonwood 962.18

2F wahe0s) 32
S" 964 A4 (I AS)
49 75 59

Cottonwood 962.89

2G Bickley
27.2" 964. 792
(1.51)3 42 57
439
Silver
Maple 963.28

See following page for footnotes 1--9.

NOTES FOR TABLE I'

1, The parties disagreed as to whether this was a single oak tree, with a diameter of 55.5", or a twin oak tree, with diameters of 26.2" and 29.3". Based upon all of the evidence, it has been treated as a single tree

2. The parties were unable to agree on the base elevation of this tree (How oak) and a number of other trees (Strzok, Loberg and Bickley). In each case, the average of the reported elevations was computed and adopted.

3. The record does not indicate whether a silver maple is a hardwood or a softwood, and thus whether the base elevation should be reduced by a full diameter or a half diameter. The average of the two (.75) was adopted. But this tree is so young that its precise reduced elevation is of little value to the ultimate issue.

4. In a number of cases Greiling had to estimate ages because the boring furnished to him did not go to the precise center ("pith") of the tree. In each case, his estimate of the additional years needed to get to the pith has been included in his age estimate.

5. Greiling estimated the age at no less than 61 years, bit believed it to be several years more. Seven years was picked as a proxy for "several".

6. Robinson provided data on the number of rings for each boring. He did not provide ages. In order to translate those numbers into ages, it is necessary add the following:

- the number of rings

- any additional years needed to correct for a boring that does not reach the exact pith (same as Note 4).

- the number of years needed to achieve breast height. The data from Ex. 12 was used, as modified by Robinscn's comments in his Report.

7. Robinson, like Greiling, noted that this core did not reach the pith, and suggested that the tree's age "may be near plus 10 or more years". The Judge has added 10 years to the number of rings actually counted.

8. Robinson reported that although there were 59 rings in the core, the boring did not reach the pith, and the curvature of the inner rings was only slight. He concluded that "The true age cannot be accurately estimated."

9. In performing the addition described in Note 6, the Judge used a figure of 7 years as the time needed to reach breast height. This was an average of hardwood (10 years) and softwood (3 years), and was used for the reason set forth in Note 3. In light of the youth of the tree, precision is really unnecessary.